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Applicant: John Ronald Rice

Examiner: n/a

Serial No.: 10/828,730

Art Group: na

Filing Date: April 21, 2004

Attorney Docket No.: 35243.00.0007

Title: **PAINTBALL GUNS**

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Respectfully submitted,

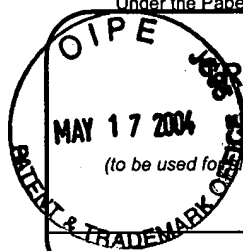
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First Named Inventor

John Ronald Rice

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ENCLOSURES (Check all that apply)☐

Fee Transmittal Form

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Drawing(s)

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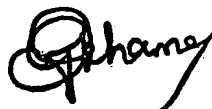
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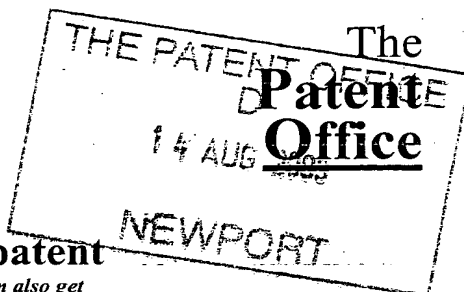


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1/77

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1. Your reference ASW1069

2. Patent application number
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0319058.4

14 AUG 2003

3. Full name, address and postcode of the or of each applicant (underline all surnames)

NPF LIMITED
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221 MOUNT STREET
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14AUG03 EB30168-4 DC2906
P01/7700 0.00-0319058.4

Patents ADP number (if you know it)

7588270001

If the applicant is a corporate body, give the country/state of its incorporation

GREAT BRITAIN

4. Title of the invention GOGGLES

5. Name of your agent (if you have one)

Barker Brettell

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

138 Hagley Road
Edgbaston
Birmingham
B16 9PW

Patents ADP number (if you know it)

7442494002

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Country

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Date of Filing
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7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

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a) any applicant named in part 3 is not an inventor, or
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(*please specify*)

11. I/We request the grant of a patent on the basis of this application.

Signature



Date

Barker Brettell

13/08/2003

12. Name and daytime telephone number of person to contact in the United Kingdom

Alan S. Wilson

Tel: 0121 456 1364

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GOGGLES

The present invention relates to goggles, and is especially suitable for sports goggles in particular paintball goggles.

5 Goggle systems for paintball generally consists of a number of items that are over and above normal eye protection. The main requirement of a paintball goggle system is that it protects the user from single or multiple strikes from paintballs that are fired from a paintball marker. Traditionally the paintballs are fired at a velocity of 300 feet/second
10 (91.44m/s) with impact energy of 9.9 foot lbs (13.42 Joules). For testing purposes the loads are higher as specified in ASTM guidelines. The goggle system must perform certain functions: retention on the user's head, maintaining lens integrity to prevent it popping out under load, and face and ear protection from paintball strikes.

15

In addition the ocular chamber is preferably ventilated to allow air to flow across the lens and face to remove condensates. However, due to the nature of the protection required the venting generally consists of apertures that must prevent a whole paintball or a broken paintball from
20 entering the ocular chamber with sufficient energy to cause eye injury. Another problem with the ventilation is that paintball is played relatively statically, and therefore forced air flow though the goggle is relatively small when compared to e.g. skiing, or motocross or any activity that will provide a ram air effect due to movement. The same problem of a lack of
25 ram air can also occur in these other sports during periods where the wearer is temporarily inactive, such as when the goggle is first put on, or during a break in activity, when it is important that the goggle does not become fogged.

30 It is a problem with some known goggle systems that the condensation that builds up within the goggle will precipitate onto the lens surface and

cause fogging. The key element in this fogging is the dew point of the air, and the fogging can occur in a warm or cold environment dependant on the relative humidity and the temperature difference between the saturated air and the lens surfaces. Also in situations where the user generates a
5 high amount of moisture due to sweating, if little or no air flow is present this alone can cause fogging.

A number of solutions to the problem of fogging in paintball goggles have been tried and are used and will now be described.

10

One known solution is to provide an anti-fog moisture absorbing coating on the inner surface of a single lens. This coating absorbs the moisture that precipitates on the surface and in doing so removes the very small droplets of water that appear as fog on the lens surface, thus maintaining
15 the optical clarity of the lens. However, a disadvantage of this type of coating is that the coating can reach saturation when it will no longer absorb water and the water can then only condense on the lens surface. Once the lens has been in an atmosphere with less humidity the process will reverse and the moisture evaporates from the lens coating. Further
20 problems with this type of coating are that the coating has a limited use in relation to the amount of moisture it can absorb, and the coating itself is very fragile and prone to scratching or marking and, should the coating become damaged, its optical properties and anti-fogging properties are substantially reduced.

25

Another solution is the use of double lenses. The purpose of this is to generate a thermal barrier within the lens structure, that works on the same principle as double glazing. The inner lens surface is warmer than the outer lens and because the inner lens remains warm the moisture laden
30 air will not condense onto the lens surface to cause fogging. A problem with double lenses is that the lenses must remain hermetically sealed to

prevent any moisture entering between them, or condensation will form between the lenses. Another problem that can be associated with double lenses is that the lens structure becomes thicker and due to its relatively close proximity to the eyes a distortion can occur causing parallax which
5 affects the optical properties of the lens.

Some manufacturers have attempted to insert fans within the goggle system in the brow area of the goggle, and these are successful to a degree. However, these systems have not provided a completely
10 satisfactory solution to the problem of fogging and often fan assisted goggles have required backing up with anti-fog or thermal lenses to get them to perform.

Accordingly the present invention provides a goggle comprising a lens, a
15 body structure supporting the lens and defining therewith an ocular chamber for extending over the eyes of a wearer, wherein the body structure further defines an exhalation chamber for extending over at least one of the nose and mouth of a wearer and an inlet chamber at least part of which is arranged to be in front of the exhalation chamber in use; the
20 goggle further comprising: a fan located in the inlet chamber, and air deflection means located between the inlet chamber and the exhalation chamber and arranged to deflect air from the fan upwards into the ocular chamber. Such an arrangement helps to prevent moisture from exhaled air reaching the lens where it can cause fogging, and also can allow better
25 control of the air flow in the ocular chamber as it is not affected by the flow of exhaled air from the wearer's nose or mouth.

Preferably the air deflection means is arranged to direct air across the lens in an upward direction. However, it can be arranged to direct air in
30 other directions such as outwards from a central nose region.

- Preferably the body structure defines an ocular chamber outlet at the upper side of the ocular chamber through which air entering the ocular chamber from the air inlet chamber can escape from the ocular chamber. Alternatively, or in addition the outlet can be at the sides of the ocular chamber. The ocular chamber outlet preferably has a covering thereover having apertures therethrough which are no greater than 15mm^2 so as to prevent debris from entering the ocular chamber. More preferably the apertures are no greater than 10mm^2 .
- 5
- 10 Preferably the inlet chamber has an inlet through which air can enter the inlet chamber from the exterior of the goggle, and the inlet is formed in the front of the goggle. This helps to ensure that the air entering the inlet has not been either exhaled by the wearer or recently passed over the head of the wearer, thereby reducing the amount of warm sweat-carrying
- 15 air entering the inlet.

Preferably the fan is positioned in a part of the inlet chamber in front of the exhalation chamber. More preferably the fan is positioned so as to be, in use, in front of the wearer's nose or mouth.

20

Preferably the inlet is below the lens, and the deflection means is arranged to direct air upwards from the inlet chamber to the inner surface of the lens. More preferably the exhalation chamber has an exhaled air outlet arranged to be, in use, below the inlet, and the exhaled air outlet is preferably arranged to direct exhaled air downwards away from the inlet.

25

Preferably the deflection means partially defines a channel having an outlet which is adjacent to the lens. This helps to promote the smooth laminar flow of air across the lens. For the same reason the air deflection means is preferably arranged to direct air in a direction substantially parallel to the lens so that the air flows across the inner surface of the

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lens, and the ocular chamber outlet is preferably positioned adjacent to the lens so that air flowing across the lens can flow on through the outlet.

5 Preferably the air deflection means shape and the fan speed are arranged to direct the air so that it flows across the lens in a substantially laminar manner. The laminar air flow can be controlled in a relatively easy manner because the ocular chamber is separate from the exhalation chamber in which the air flow will be affected by the breath of the wearer.

10

Preferably the air deflection means is arranged to direct the air flow in the ocular chamber so that it occurs mostly in a region of the ocular chamber adjacent to the lens and spaced from the wearer's face.

15 The present invention further provides a goggle comprising a lens, a body structure supporting the lens and defining an air inlet means arranged to direct air from the exterior of the goggle across an inner surface of the lens, a fan located in the air inlet means for causing air to flow through the air inlet means, and a drive system for driving the fan wherein the
20 drive system includes a controller arranged to switch the fan repeatedly between an on state and an off state so as to control the amount of air directed across the lens, and to control the timing of the switching so that each time the fan is switched to the on state it remains in that state for at least a predetermined time to allow for air flow across the lens to reach a
25 steady state.

Preferably the controller is arranged to vary the length of the periods for which the fan is in at least one of the on state and the off state so as to vary the amount of air flow across the lens.

30

Preferably the drive system includes a sensing means arranged to sense a condition which will affect fogging of the lens, and the controller is arranged to control operation of the fan in response to a signal from the sensing means.

5

Indeed the present invention still further provides a goggle comprising a lens, a body structure supporting the lens and defining an air inlet means arranged to direct air from the exterior of the goggle across an inner surface of the lens, a fan located in the air inlet means for causing air to
10 flow through the air inlet means, and a drive system for driving the fan wherein the drive system includes a sensing means arranged to sense a condition which will affect fogging of the lens, and a controller arranged to control operation of the fan in response to a signal from the sensing means.

15

The sensing means preferably includes a temperature sensor arranged to measure the temperature in a region close to the lens, and also preferably comprises a humidity sensor arranged to measure the humidity of air in a region within the goggle close to the lens.

20

The goggle preferably further comprises a strap formed from a piece of elastomeric material.

Indeed the present invention yet further provides a goggle comprising a
25 lens a body structure supporting the lens and a strap connected to the body structure wherein the strap is formed from a piece of elastomeric material.

Preferably the strap is connected to the body structure by means of
30 pivoting connectors. Preferably the strap has a number of apertures

formed therethrough. More preferably the strap is sufficiently flexible to be non-adjustable.

Preferred embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a front perspective view of a goggle according to a first embodiment of the invention in use by a wearer;

Figure 2 is a rear perspective view of the goggle and wearer of Figure 1;

Figure 3 is a vertical section through the goggle of Figure 1;

Figure 4 is a partially cut-away side view of the goggle of Figure 1;

Figure 5 is a partially cut-away front perspective view of the goggle of Figure 1;

Figure 6 is a partially cut-away front view of the goggle of Figure 1;

Figure 7 is a further partially cut-away view of the goggle of Figure 1;

Figure 8 is a schematic diagram of a control system for the goggle of Figure 1;

Figures 9, 10 and 11 show the drive current of a fan motor forming part of the goggle of Figure 1 under various conditions;

Figure 12 is a schematic diagram of a control system for a goggle according to a second embodiment of the invention;

Figure 13 is a schematic diagram of a control system for a goggle according to a third embodiment of the invention;

- 5 **Figure 14** is a schematic diagram of a control system for a goggle according to a fourth embodiment of the invention;

Figure 15 is a schematic diagram of a control system for a goggle according to a fifth embodiment of the invention;

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Figure 16 is a schematic diagram of a control system for a goggle according to a sixth embodiment of the invention; and

- 15 **Figure 17** is section similar to Figure 3 through a goggle according to an eighth embodiment of the invention.

Referring to Figures 1 to 3, a goggle system 10 comprises a one-piece single lens 12 supported in a moulded plastics body 14 which can be moulded as a number of separate parts; a strap 16 arranged to pass around the rear of a wearer's head 18 for securing the goggle in position on the head 18 of the wearer, and a visor 20.

The body 14 is of a semi-rigid, flexible construction such that it can follow, and fit to, the contours of the wearers face when it is worn. The body 14 comprises a lens frame portion 22, which surrounds and supports the lens 12, a nose protection portion 24, a jaw protection portion 26, and ear protection portions 28 on either side. A gasket 30, shown also in Figure 6, extends around the inside of the frame portion 22 and is arranged to rest against the wearer's face 32 around his eyes when the goggle is in use thereby providing the main location for the goggle 10. When in use, the lens 12, the lens supporting portion 22 of the body 14,

and the gasket 30 form a first chamber in the form of an ocular chamber 34 in front of the wearer's eyes 35 and behind the lens 12. The nose protection portion 24 and jaw protection portion 26 define an exhalation chamber 36 in front of the wearer's mouth 38 and nose 40, the top of which is defined by the lower portion 30a of the gasket 30 which fits over the bridge of the wearer's nose 40 and provides a seal between the ocular chamber 34 and the nose and mouth chamber 36.

In the centre of the body 14 below the lens 12 an air inlet means in the form of a duct or plenum channel 42 is formed. This plenum channel 42 has a broad inlet chamber 44 with a fan 46 mounted in it, driven by an electric motor 47 (see Figure 8). The fan is arranged to rotate about a substantially horizontal axis drawing air in from the forward direction and propelling it in a rearward direction towards the exhalation chamber 36.

The front of the inlet chamber 44 is formed by an inlet cover portion 48 of the body which has a number of apertures 50 formed through it. In the back 52 of the inlet chamber a fan chamber 51 is formed being surrounded by a fan chamber wall 53 and opening at the front into the inlet chamber 44. From the back of the fan chamber 51, an upper part 42a of the plenum channel 42 extends upwards into the ocular chamber 34. The back of the plenum channel 42 is formed by a substantially vertical crescent shaped air divertor plate 54 which separates the plenum channel 42 from the nose and mouth chamber 36, and deflects air from the fan 46 upwards towards the ocular chamber 34. The back 54a of this divertor plate 54 carries the lower part of the gasket 30 which seals against the wearer's face in the region over his nose 40. The front of the upper part 42a of the plenum channel 42 is formed by the lens frame portion 22 of the body 14. The upper part 42a of the plenum channel 42 is therefore wide and flat and crescent shaped opening into the ocular chamber 34 adjacent to the lower edge 12a of the lens 12. The lens 12 is convex, as can be seen in Figure 3, and the top end 42b of the plenum channel 42

directs air travelling along it in a direction substantially parallel to the plane of the lower edge 12a of the lens 12.

5 It will be appreciated that as the plenum channel 42 turns through a substantially right angle bend between the inlet chamber 44 and the upper part 42a, there is no straight-line path by means of which objects such as paintball parts or stones can enter the ocular chamber 34 to reach the wearer's eyes. This is an important safety requirement.

10 The bottom of the exhalation chamber 36 is formed by part of the jaw protection portion 26 of the body 14. This has a number of apertures 56 through it to allow air to enter the exhalation chamber 36 for the wearer to breath in, and to allow air exhaled by the wearer to escape. A web 53a extends between the region where the jaw protection portion 26 is joined
15 to the inlet cover portion 48, and the lower edge of the fan chamber wall 53. The web 53a therefore forms a seal preventing air from flowing from the exhalation chamber round the lower edge of the fan chamber wall 53 into the inlet chamber 44.

20 The top of the lens frame portion 22 above the lens 12 forms a top wall 34a of the ocular chamber 34 which extends substantially perpendicular to the lens 12, being substantially horizontal in use, as can best be seen in Figure 3. This top wall 34a extends across the whole width of the lens 12 and has apertures 34b through it over the whole of its length. The size of
25 these apertures is chosen, in accordance with ASTM guidelines, to prevent paintball fragments or other debris from entering the ocular chamber where they might damage the wearer's eyes. The top wall 34a is level, in the vertical direction, with the top of the gasket 30, and is therefore spaced from the wearer's head 18 by the thickness of the gasket
30 30. The apertures 34b extend forwards to the front edge 34c of the top wall 34a substantially as far as the edge of the lens 12, so that air

travelling upwards over the surface of the lens can pass out through the apertures 34b without a substantial change of direction.

Referring to Figure 6 a power module 60 for the fan 46 is mounted inside
5 the body 14 to one side of the inlet plenum channel 42, just below the
ocular chamber 34. The power module 60 contains batteries 62 for
powering the fan 46, control electronics in the form of an integrated
circuit board 64 for controlling the speed of the fan 46 and a tactile
switch 66 which allows the wearer to turn the fan on and off and adjust
10 the speed of the fan when it is running. A power lead 68 connects the
power module 60 to the fan motor 47. The power module 60 also has an
LED 70 within it, and a light guide 72 extends upwards from the power
module 60 through the gasket 30 into the ocular chamber 34 where its
upper end 74 provides a visual indicator to the wearer. Figure 8 shows
15 the components of the fan drive system in the form of a block diagram.

Referring to Figures 1, 3, 4 and 5, when the fan 46 is running air is
drawn into the inlet chamber 44 as indicated by the arrows A and through
the fan chamber 51 past the fan 46, and then is directed upwards from the
20 back 51 of the fan chamber by the deflector plate 54 up the upper part
42a of the plenum channel 42 into the ocular chamber 34. When it
reaches the ocular chamber 34 it exits the top 42b of the plenum channel
42, travelling upwards and outwards across the inner surface 12a of the
lens 12 as shown by arrows B. As can be seen most clearly in Figures 1
25 and 5, because the plenum channel 42 is arched over the wearer's nose,
the air B spreads across the lens 12 in fan-shaped path, travelling over
substantially the whole area of the lens 12. When it reaches the top of the
lens it exits through the outlet apertures 34b in the top of the ocular
chamber 34, as shown by arrows D. Because the outlet from the plenum
30 channel 42 and the apertures 34b in the top of the ocular chamber are
close to, and in fact directly adjacent to, the lens 12, the air B travels up

the inner surface of the lens 12 in a laminar flow layer. The total cross sectional area of the apertures 34b is made greater than the area of the outlet of the plenum channel 42 so that there is no build up of pressure in the ocular chamber, and so as to encourage the smooth laminar flow of air across the lens 12. The speed of the fan 42 is also controlled so that the air speed across the lens remains low enough for the laminar flow to remain stable. This is so that turbulent flow, which can result in air being directed towards the wearer's eyes, is avoided. A further advantage of this thin layer of laminar flow is that it produces a lower pressure region in the ocular chamber adjacent to the lens, and this tends to draw air away from the wearer's face 32, as shown by arrows C, into the upwards flow and out through the top of the ocular chamber 34. This aids the evaporation and removal of sweat from the wearer's face. A further advantage of the upward flow across the lens is that convection caused by heat from the wearer's face contributes to the upward flow and does not disturb the smooth laminar flow.

As can best be seen in Figures 3 and 4, the flow of air to and from the wearer's mouth 38 and nose 40 as he breathes is through the exhalation chamber 36 and through the apertures 56 in the jaw protection portion 26 of the goggle, as well as between the very bottom edge 26a of the goggle and the wearer's jaw 58. Because these apertures are in the lower part of the goggle and face in a generally downward direction, air exhaled by the wearer is generally directed downwards away from the goggle, as shown by arrows E, and therefore also away from the inlet 44 which is in the front of the goggle facing in a generally forward direction. This means that the moisture in the wearer's breath is directed away from the inlet 44 to the plenum channel 42 and therefore tends not to enter the ocular chamber 34, which is beneficial in avoiding fogging of the lens 12.

Referring to Figure 7, as the air B spreads upwards across the lens 12, it clears any fogging from the lens in regions F, G, H, I, J which are at increasing distance from the outlet of the plenum channel 42. Therefore the region F at the lowest part of the lens 12 arched around the nose 40 of the wearer clears first as it is closest to the outlet of the plenum channel 42. The regions then clear in order until the topmost region J which extends across the top of the lens 12 closest to the apertures 34b. The steady laminar flow of air over the lens ensures that the fogging always clears in this regular manner.

10

Referring to Figure 9, in its simplest form the control electronics 64 controls the fan 46 between an off state and an on state. Figure 9 shows how the drive current to the fan motor 47 can be turned on at time t_1 and off again at time t_2 . The motor could simply be turned on and off in response to the wearer's operation of the switch 66. However, in this embodiment the control electronics 64 are arranged to pulse the fan on and off as shown in Figure 10. Each time the fan is turned on it is kept on for at least a minimum on-time, which in this case is of the order of one or two seconds, which is long enough to allow the flow of air across the lens 12 to build up and settle in the steady state laminar flow. This ensures that the fan can operate under optimum conditions. Between each on-time the fan is turned off. The on- and off-times are controlled to the optimum length, which in this embodiment is fixed, to produce a satisfactory speed of clearing of the lens without producing too rapid a drain on the power of the batteries 62. The exact timing of the switching on and off of the motor can be varied in a number of ways depending on the type of goggle and the circumstances under which it is expected to be used. For example it can be turned on for a single continuous period of predetermined length when first switched on by the switch 66 so as to clear the lens 12 as rapidly as possible, and then switch to a pulsing on and off to keep the lens 12 clear but preserve battery power.

30

While the fan is switched on at the switch 66, the control module 60 keeps the LED 70 switched on which is visible to the wearer through the light guide 74 as an indicator that the fan is switched on. This is particularly useful where the fan motor 47 is a quiet brushless motor, such as an induction motor, in which case it can be hard for the wearer to tell whether the fan is running or not, particularly if the goggle is being worn in a noisy environment.

10 Referring to Figure 12, in a second embodiment of the invention the fan control system includes control electronics 164, a battery 162, a switch 166 and a fan motor 147, but the LED is omitted.

Referring to Figure 13, in a third embodiment the motor control system includes all of the components of the first embodiment, which are indicated by the same reference numeral increased by 200, but further includes a photo sensor 260 mounted at a suitable position on the goggle body 16 to detect the ambient light level. The control electronics 264 then uses the signal from the photo sensor 260 to control the level of light produced by the LED 270 so as to be at a suitable level relative to the ambient light.

Referring to Figure 14, in a fourth embodiment of the invention the fan control system includes all of the features of the third embodiment, indicated by the same reference numerals but increased by a further 100, and also includes a temperature sensor 378 mounted on the goggle body 16 inside the ocular chamber 34. The temperature sensor 378 sends signals to the control electronics 364 indicative of the temperature in the ocular chamber 34, and the control electronics 364 vary, and control, the length of the on- and off- time pulses of the motor 347 in response to changes in the measured temperature. Since fogging occurs when the air

within the ocular chamber 34 reaches its dew point due to either falling temperature or increasing humidity, the fan 46 is controlled so as to increase the air flow across the lens 12 as the temperature falls. This can conveniently be done by controlling the off-time between pulses of power
5 to the fan 46, and optionally also the length of the on-time pulses.

The exact position of the temperature sensor 378 is important in determining the system's effectiveness in anticipating fogging. Preferably it is mounted on or very near to the lens 12, as the most common cause of
10 fogging is cooling of the air in the ocular chamber 34 by the lens 12.

With reference to Figure 15, in a fifth embodiment of the invention the fan control system includes all of the features of the fourth embodiment, indicated by the same reference numerals but increased by a further 100, and also includes a humidity sensor 479 mounted on the goggle body 16
15 within the ocular chamber 34. This sends signals to the control electronics 464 indicative of the humidity of the air within the ocular chamber 34. The control electronics respond by increasing the amount of air blown across the lens 12 in response to an increase in humidity.

20 Finally, referring to Figure 16, in a sixth embodiment of the invention the fan control system includes all of the features of the fifth embodiment, indicated by the same reference numerals but increased by a further 100, and also includes a panel of solar cells 580. The solar panel 580 can be mounted on the exterior of the goggle body 16, or alternatively on the
25 interior of the ocular chamber 34, for example along the bottom of the ocular chamber to either side of the plenum channel 42, where it will be protected by the lens 12. The solar panel 580 produces electrical power which is either used directly to drive the fan or stored in the battery 546, under the control of the control electronics 564.

Referring back to Figure 2, the strap 16 is connected to the goggle body 14 by means of pivoting connectors 90 which each include a tag 92 pivotally mounted on a support 94 so that it can pivot about an axis which is, when in use with the wearers head upright, substantially horizontal and transverse to the goggle. The strap is connected at each end to one of the tags 92 so that when the strap 16 is moved up and down the back of the wearer's head 18, the angle of the strap 16 can change relative to the body 14 without tending to tilt the body 14 on the wearer's face. The visor 20 is pivotally mounted on the same supports 94 so that it can be pivoted up and down to vary the amount of shading it provides for the user's face. The strap 16 is made of a strip of moulded elastomeric material having a number of perforations or apertures 96 through it which are formed with soft curved edges so as to avoid tear stress points. The apertures 96 are in two parallel rows along the strap. The apertures 96 through the strap 16 serve a number of purposes. They allow the strap 16 to stretch easily to fit the wearer's head 18, in this embodiment to a sufficient degree to avoid the need for an adjustment buckle altogether. This non-adjustability makes the strap 16 more comfortable and easier to use than conventional straps. Also the apertures 96 allow perspiration forming on the wearer's head 18 to evaporate more easily as they reduce the amount of surface area of the wearer's head which is covered. For this reason it is desirable that the apertures 96 take up a relatively large proportion of the area of the strap, in this case approximately half of its total surface area. Furthermore, the use of elastomeric material for the strap 16 prevents the propagation of bacteria in the strap thereby avoiding unpleasant odours, and avoids the need for silicone beading used on conventional fabric straps.

Referring to Figure 17 a seventh embodiment of the invention a goggle system 610 is designed to be similar to the first embodiment of Figures 1 to 7, with corresponding parts indicated by the same reference numerals

preceded by a 6. In this embodiment the exhalation chamber 636, while being separate from the ocular chamber 634, and the fan chamber 644, is not sealed off from them. Limited air flow can therefore occur between the chambers, but the air pressures in the chambers 634, 636, 644
5 produced by the fan 646, are such that the air flow does not significantly affect the de-fogging of the lens 612.

The divertor plate 654 has a number of small apertures 654a through it behind the fan 646 to allow some air flow from the inlet chamber 644 into
10 the exhalation chamber. This helps to provide a continuous supply of fresh air for the wearer to breathe. However, the apertures 654a are small enough to ensure that the majority of the air from the inlet chamber 644 is diverted upwards onto the inner surface 612a of the lens 612. Also because the fan 646 creates a region of high pressure in the back 652 of
15 the inlet chamber 644, this region will generally be at a higher pressure than the exhalation chamber 636, and air exhaled by the wearer will generally not be able to pass from the exhalation chamber forwards through the divertor plate 654 into the inlet chamber 644.

20 A deflector 653a extends downwards from the fan chamber wall 53 towards the jaw protection portion 626 of the goggle 610, but stops short of the jaw protection portion 626 so that a small opening 653b is left between them. This deflector 653a acts to deflect exhaled air downwards away from the inlet chamber 644 and therefore serves the same function
25 as the web 53a of Figure 3, but without forming a total seal between the exhalation chamber 636 and the inlet chamber 644. In this case it is the shape of the deflector 653a and the direction of flow of the exhaled air which ensure that no significant amount of exhaled air passes into the inlet chamber 644.

At the lower edge of the lens 612 a grille 630b is formed in the lens frame portion 622. This extends across the whole of the lower edge of the lens 612, and over the top of the plenum channel 42 where it opens into the ocular chamber 634. The grille 630b comprises a plastics moulding
5 with a number of small apertures through it. At the sides of the goggle, to either side of the divertor plate 653, the grille 630b provides limited communication between the ocular chamber 34 and the exhalation chamber 636. However, as the fan blows air up into the ocular chamber, the pressure in the ocular chamber 634 is higher than in the exhalation
10 chamber 636, so air tends to flow down from the ocular chamber 634 into the exhalation chamber 636 and not in the opposite direction.

It will be appreciated that preferred embodiments of the invention can successfully control a number of factors to reduce fogging of the goggle
15 lens. The air flow distribution across the lens can be controlled to provide rapid and uniform de-fogging, the non-turbulent air flow within the ocular chamber helps to prevent air flowing across the ocular region and causing dryness of the eye and leading to irritation. These are both achieved by control of the fan speed and air flow direction. Also the selection of a
20 suitable fan and motor can help to keep noise to a minimum.

CLAIMS

1. A goggle comprising a lens, a body structure supporting the lens and defining therewith an ocular chamber for extending over the eyes of a wearer, wherein the body structure further defines: an exhalation chamber
5 for extending over at least one of the nose and mouth of a wearer and an inlet chamber at least part of which is arranged to be in front of the exhalation chamber in use; the goggle further comprising a fan located in the inlet chamber, and air deflection means located between the inlet chamber and the exhalation chamber and arranged to deflect air from the
10 fan upwards into the ocular chamber.

2. A goggle according to claim 1 wherein the air deflection means is arranged to direct air across the inner surface of the lens in an upward direction.

15

3. A goggle according to claim 1 or claim 2 wherein the body structure defines an ocular chamber outlet at the upper side of the ocular chamber through which air entering the ocular chamber from the inlet chamber can escape from the ocular chamber.

20

4. A goggle according to claim 3 wherein the outlet has a covering thereover having apertures therethrough which are no greater than 30mm² so as to prevent debris from entering the ocular chamber.

25 5. A goggle according to any foregoing claim wherein the inlet chamber has an inlet through which air can enter the inlet chamber from the exterior of the goggle.

6. A goggle according to claim 5 wherein the inlet is formed in the
30 front of the goggle.

7. A goggle according to any foregoing claim wherein the fan is positioned in a part of the inlet chamber in front of the exhalation chamber.
- 5 8. A goggle according to any foregoing claim wherein the fan is positioned so as to be, in use, in front of the wearer's nose or mouth.
9. A goggle according to any foregoing claim wherein the exhalation
10 chamber has at least one exhaled air outlet for exhaled air.
10. A goggle according to claim 9 when dependent on claim 5 or claim 6 wherein the exhaled air outlet is arranged to be, in use, below the inlet.
15
11. A goggle according to claim 9 or claim 10 wherein the exhaled air outlet is arranged to direct exhaled air downwards away from the inlet chamber.
- 20 12. A goggle according to any foregoing claim wherein the deflection means partly defines a channel between the inlet chamber and the ocular chamber, the channel having an outlet which is adjacent to the lens.
13. A goggle according to claim 12 wherein the channel outlet is
25 arranged to direct air in a direction substantially parallel to the lens so that the air flows across the inner surface of the lens.
14. A goggle according to claim 3 or any claim dependent thereon wherein the ocular chamber outlet is positioned adjacent to the lens so
30 that air flowing across the lens can flow on through the outlet.

15. A goggle according to any foregoing claim wherein the deflection means is arranged to direct the air so that it flows across the lens in a substantially laminar manner.
- 5 16. A goggle according to any foregoing claim wherein the air deflection means is arranged to direct the air flow in the ocular chamber to occur mostly in a region of the ocular chamber adjacent to the lens and spaced from the wearer's face.
- 10 17. A goggle according to any foregoing claim further comprising a partition between the ocular chamber and the exhalation chamber to inhibit the flow of air from the exhalation chamber to the ocular chamber.
- 15 18. A goggle according to claim 17 wherein the partition is sealed to prevent the flow of air from the exhalation chamber to the ocular chamber.
- 20 19. A goggle according to claim 17 wherein the partition defines at least one opening through which air can flow from the ocular chamber to the exhalation chamber.
- 25 20. A goggle according to any foregoing claim in which the air deflection means comprises at least part of a partition between the inlet chamber and the exhalation chamber to inhibit the flow of air from the exhalation chamber to the inlet chamber.
- 30 21. A goggle according to claim 20 wherein the partition between the inlet chamber and the exhalation chamber is sealed to prevent the flow of air from the exhalation chamber to the inlet chamber.

22. A goggle according to claim 20 wherein the partition between the inlet chamber and the exhalation chamber defines at least one opening through which air can flow from the inlet chamber to the exhalation chamber.

5

23. A goggle comprising a lens, a body structure supporting the lens and defining an air inlet means arranged to direct air from the exterior of the goggle across an inner surface of the lens, a fan located in the air inlet means for causing air to flow through the air inlet means, and a
10 drive system for driving the fan wherein the drive system includes a controller arranged to switch the fan repeatedly between an on state and an off state so as to control the amount of air directed across the lens, and to control the timing of the switching so that each time the fan is switched to the on state it remains in that state for at least a predetermined time to
15 allow for air flow across the lens to reach a steady state.

24. A goggle according to claim 23 wherein the controller is arranged to vary the length of the periods for which the fan is in at least one of the on state and the off state so as to vary the amount of air flow across the
20 lens.

25. A goggle according to claim 23 or claim 24 wherein the drive system includes a sensing means arranged to sense a condition which will affect fogging of the lens, and the controller is arranged to control
25 operation of the fan in response to a signal from the sensing means.

26. A goggle comprising a lens, a body structure supporting the lens and defining an air inlet means arranged to direct air from the exterior of the goggle across an inner surface of the lens, a fan located in the air
30 inlet means for causing air to flow through the air inlet means, and a drive system for driving the fan wherein the drive system includes a

sensing means arranged to sense a condition which will affect fogging of the lens, and a controller arranged to control operation of the fan in response to a signal from the sensing means.

- 5 27. A goggle according to claim 25 or claim 26 wherein the sensing means includes a temperature sensor arranged to measure the temperature in a region close to the lens.
- 10 28. A goggle according to any of claims 25 to 27 wherein the sensing means includes a humidity sensor arranged to measure the humidity of air in a region within the goggle close to the lens.
- 15 29. A goggle according to any foregoing claim further comprising a strap formed from a piece of elastomeric material.
30. A goggle comprising a lens, a body structure supporting the lens and a strap connected to the body structure wherein the strap is formed from a piece of elastomeric material.
- 20 31. A goggle according to 29 or claim 30 wherein the strap is connected to the body structure by means of pivoting connectors.
- 25 32. A goggle according to any of claims 29 to 31 wherein the strap has a number of apertures formed therethrough.
33. A goggle according to any of claims 29 to 32 wherein the strap is non-adjustable.
- 30 34. A goggle according to any of claims 29 to 33 wherein the strap is arranged to pass around the rear of a wearer's head.

35. A goggle according to any foregoing claim wherein the body structure is of a flexible construction thereby being arranged to follow the contours of a wearer's face.
- 5 36. A goggle substantially as hereinbefore described with reference to Figures 1 to 11, Figure 12, Figure 13, Figure 14, Figure 15, Figure 16 or Figure 17 of the accompanying drawings.

ABSTRACT**GOGGLES**

A goggle, for use, for example, in paintball, comprises a lens 12 a body
5 structure 14 for the lens and a strap 16. The body structure defines an
ocular chamber 34 which covers the wearer's eyes, and an exhalation
chamber 36 which covers the wearer's nose and mouth. An inlet plenum
channel 42 leads from an inlet chamber 44 in the front of the goggle 10
up to the lower edge of the lens 12, and a fan 46 in the plenum channel
10 42 blows air from the inlet upwards across the inner surface of the lens
12. Air exhaled by the wearer leaves the exhalation chamber through
outlet apertures 56 in the bottom of the mask, and is therefore directed
away from the duct inlet chamber 44.

15 (To be accompanied, when published, by Figure 3 of the drawings.)

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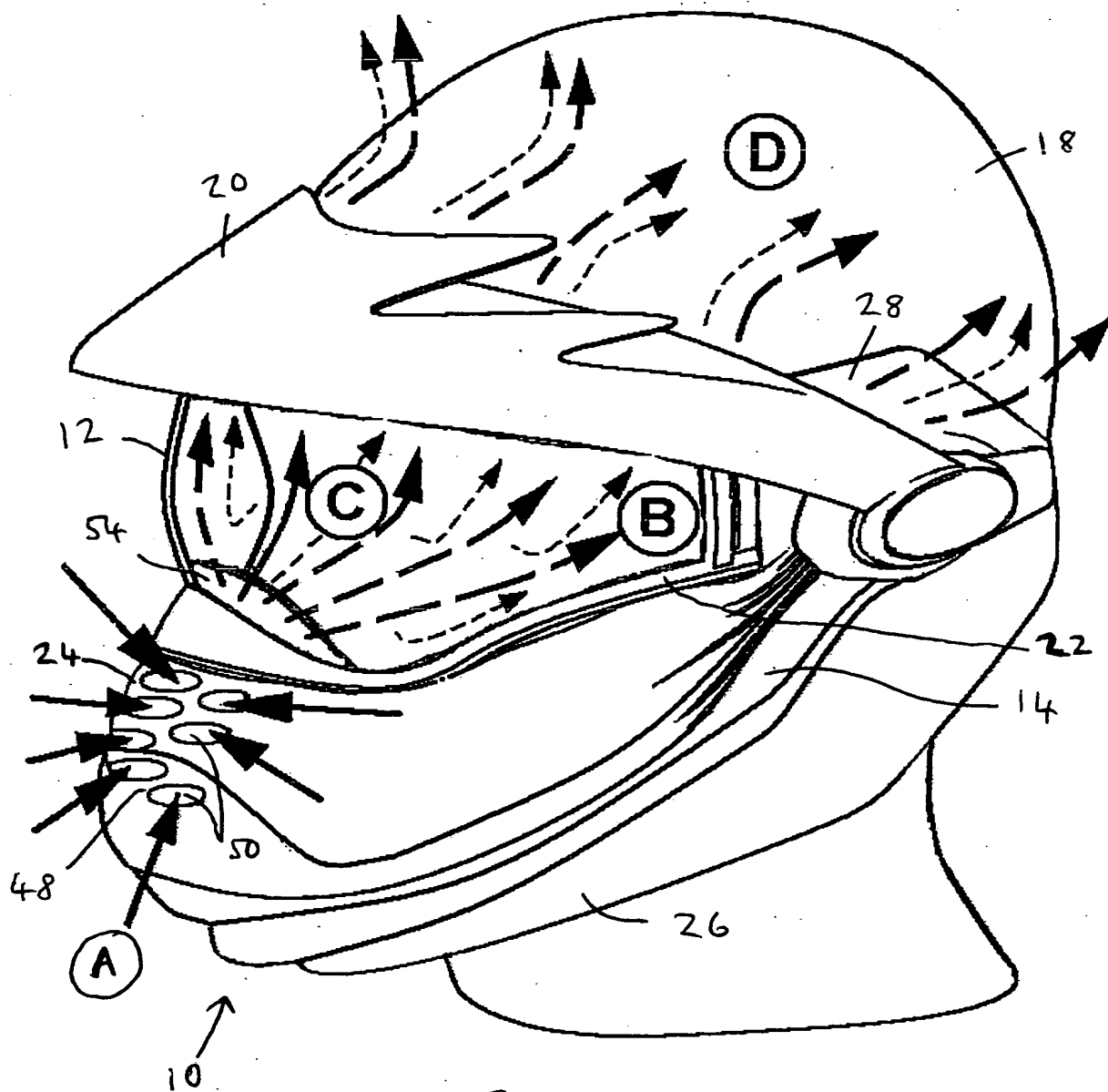
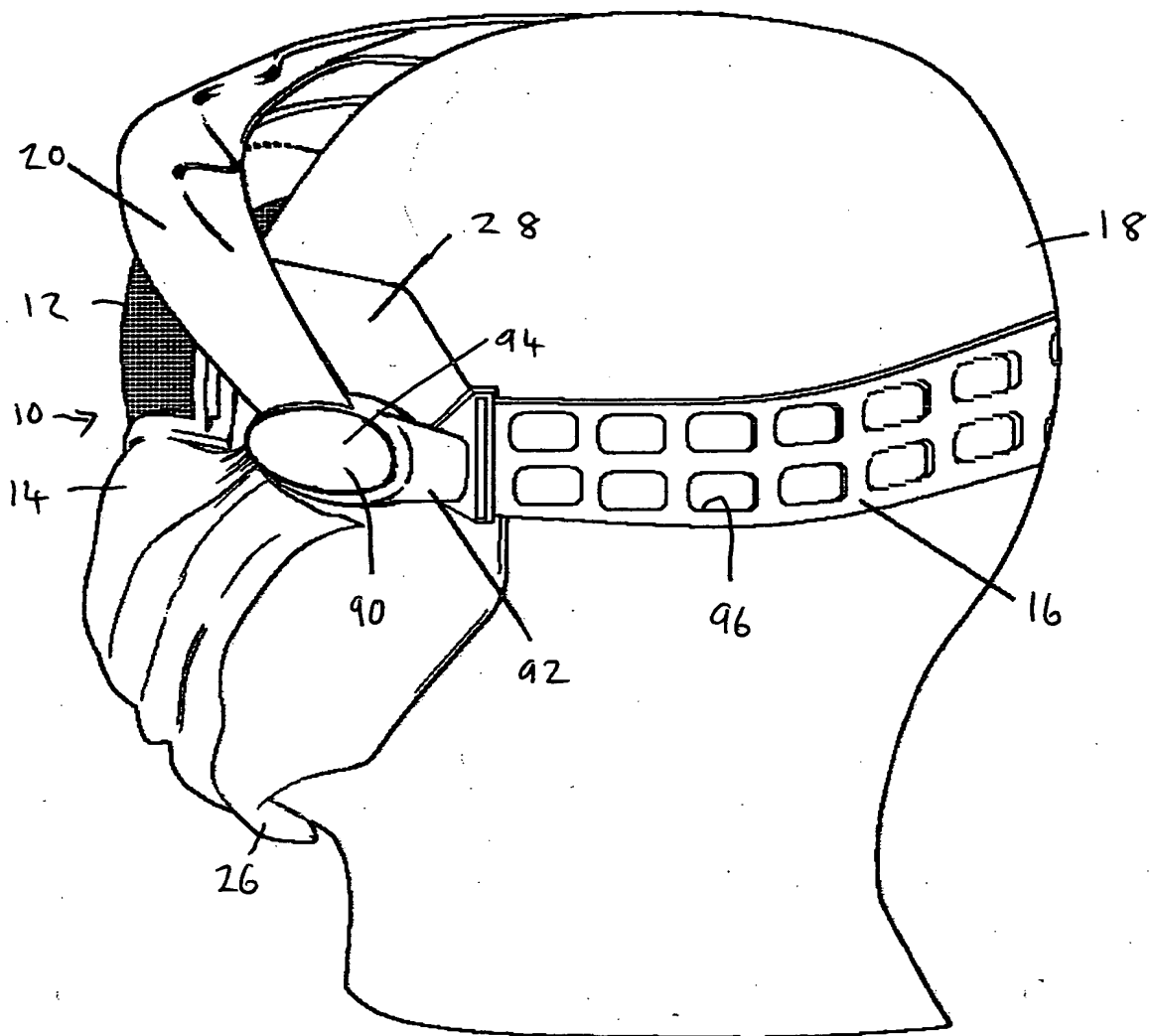


Fig 1

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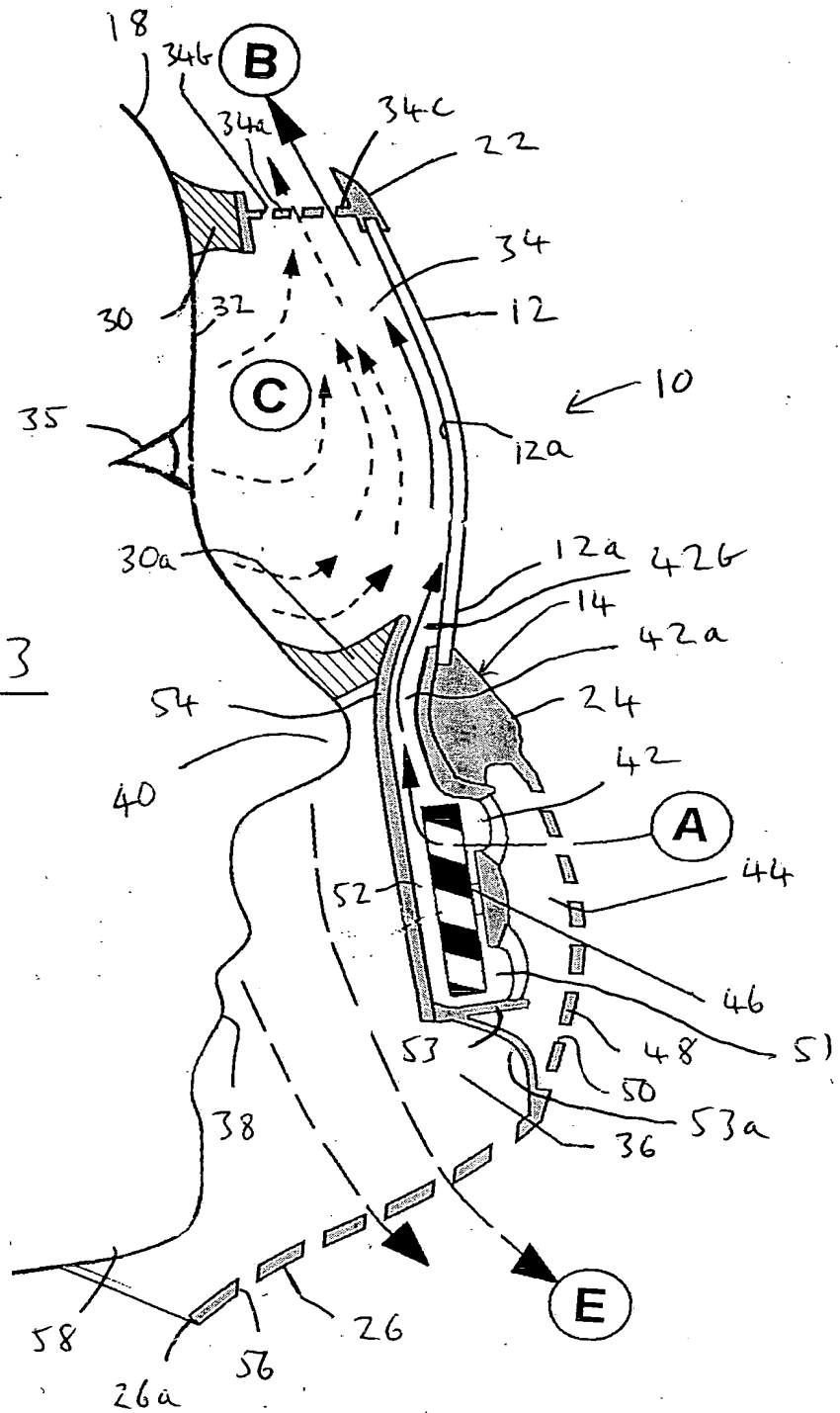
Fig 2



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Fig 3



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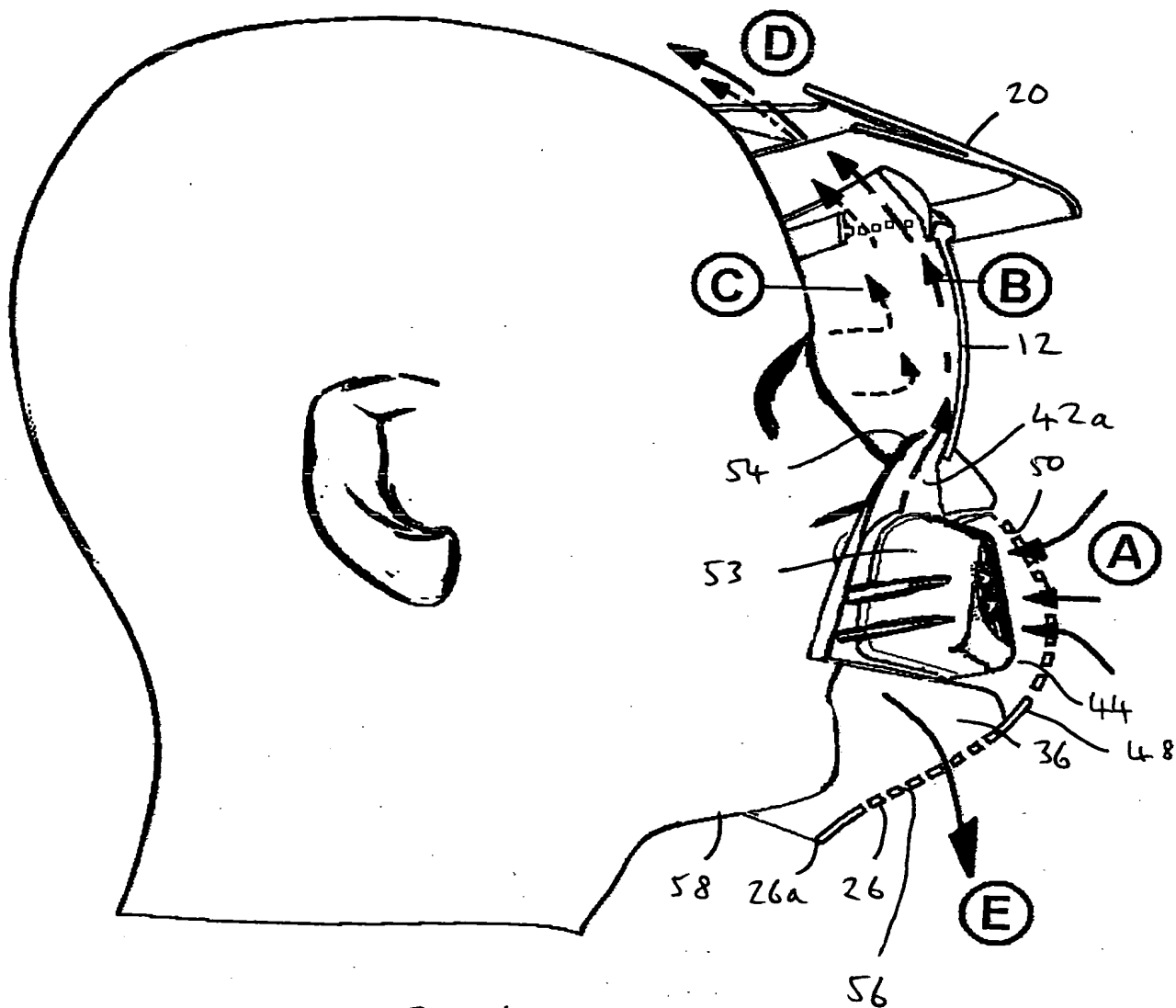


Fig 4

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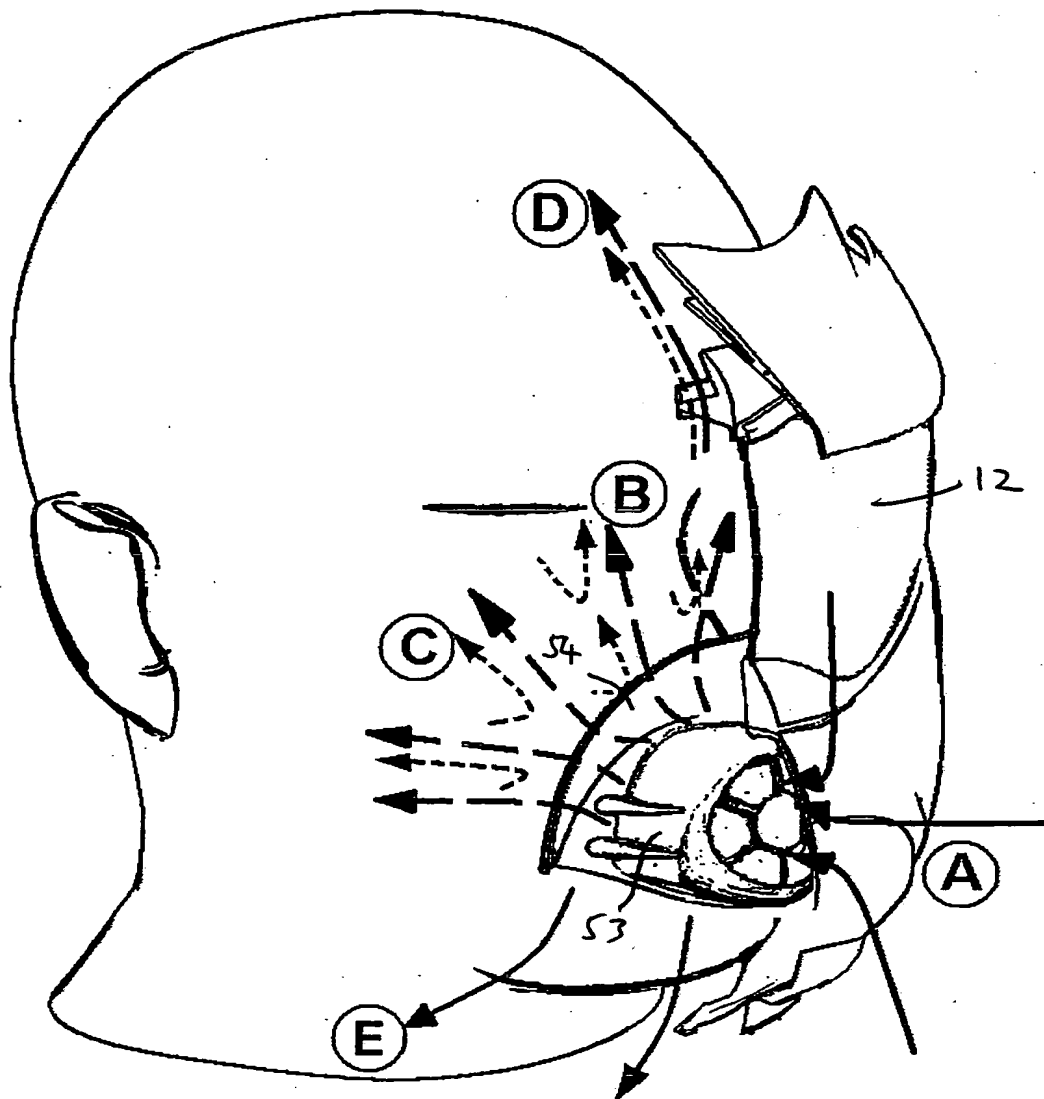


Fig 5

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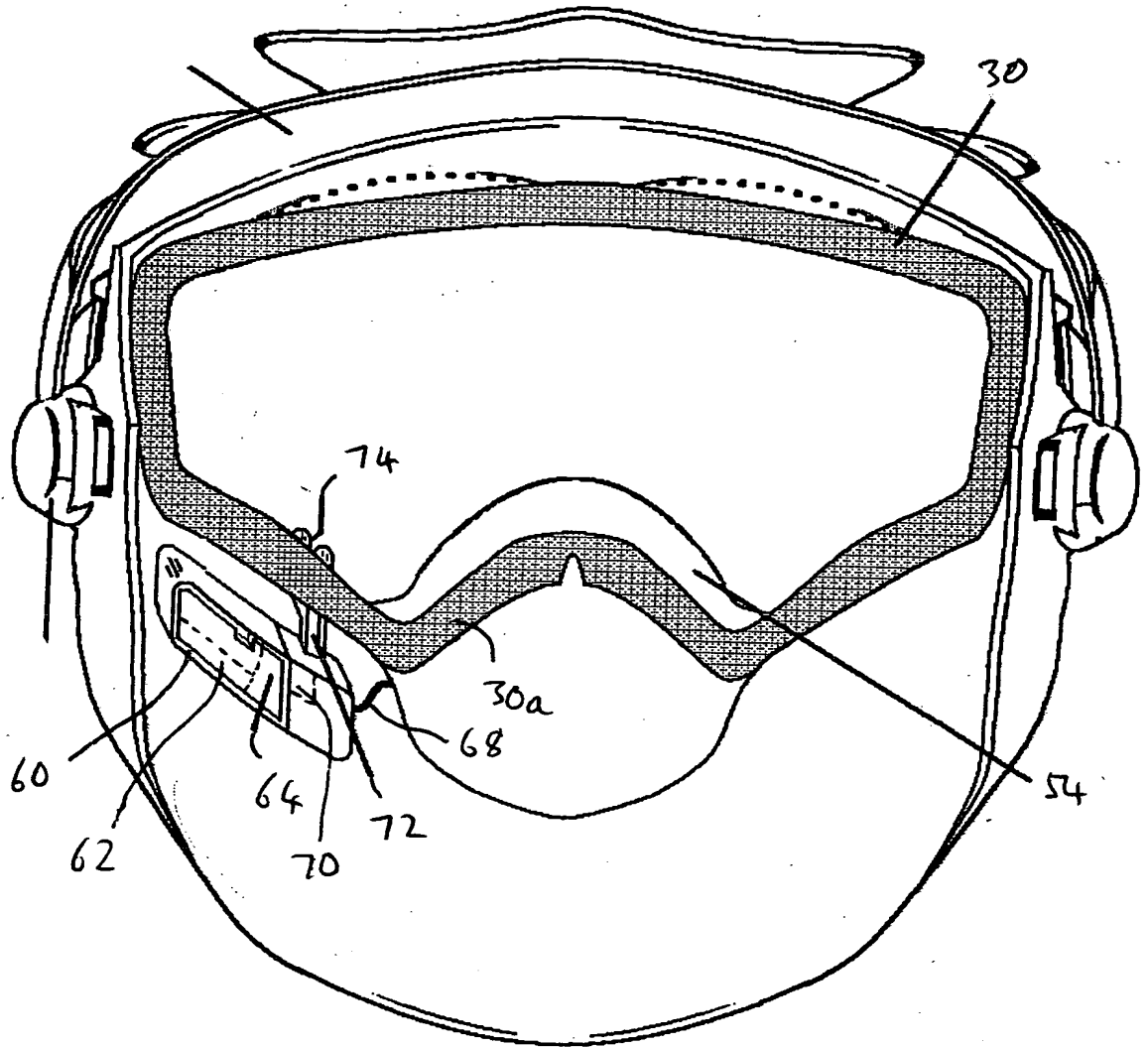


Fig 6

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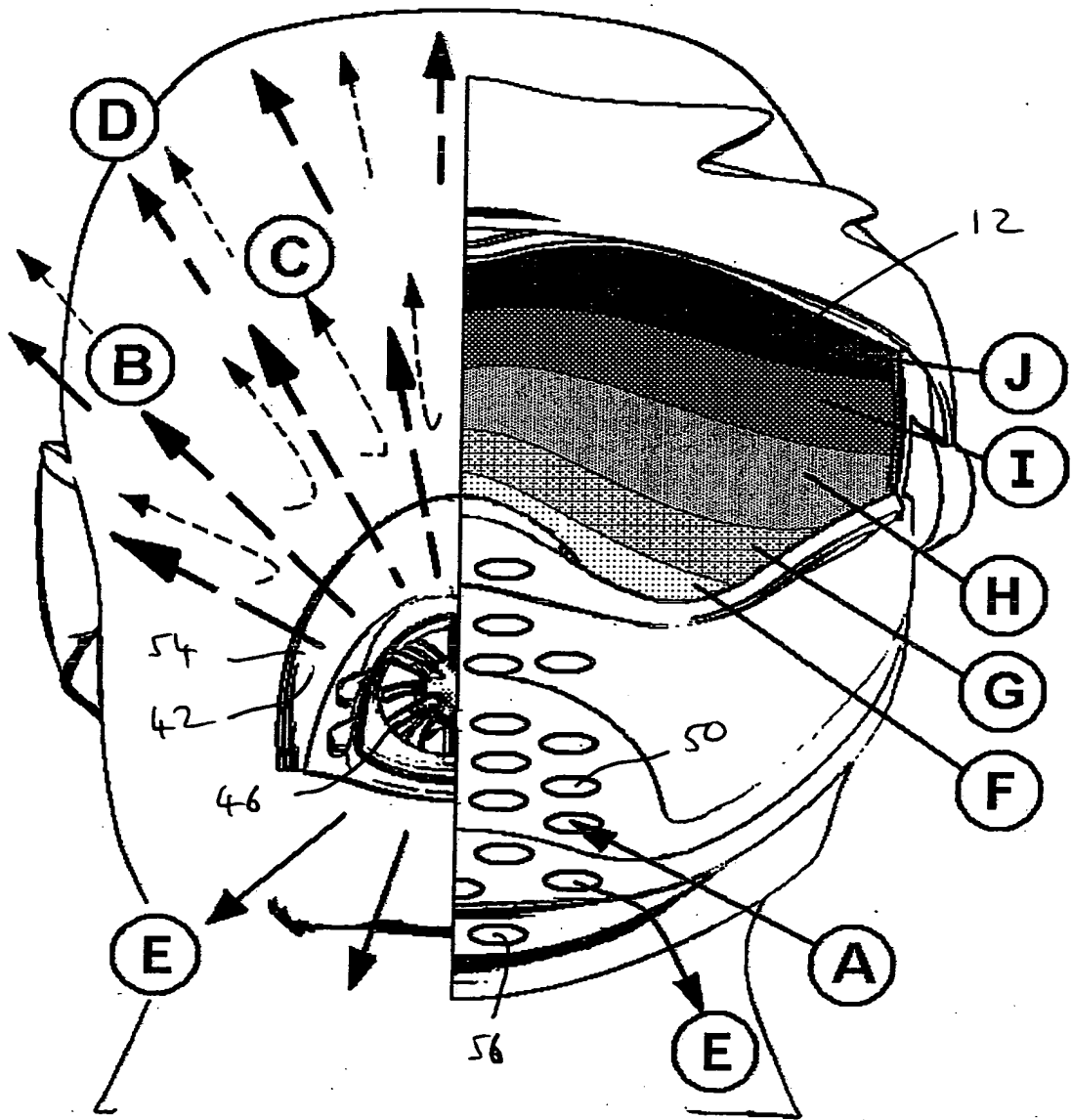


Fig 7

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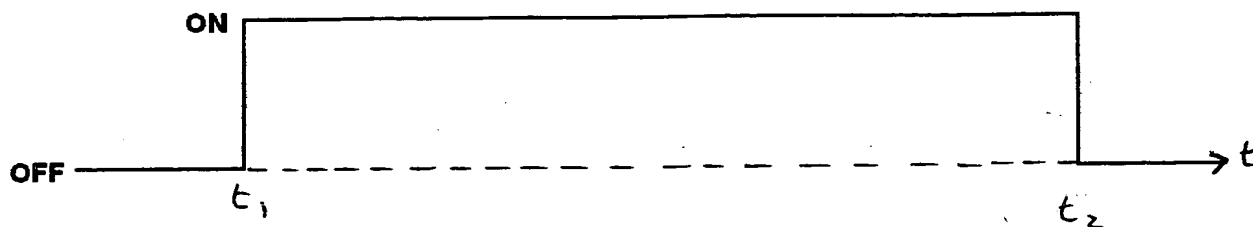


Fig 9

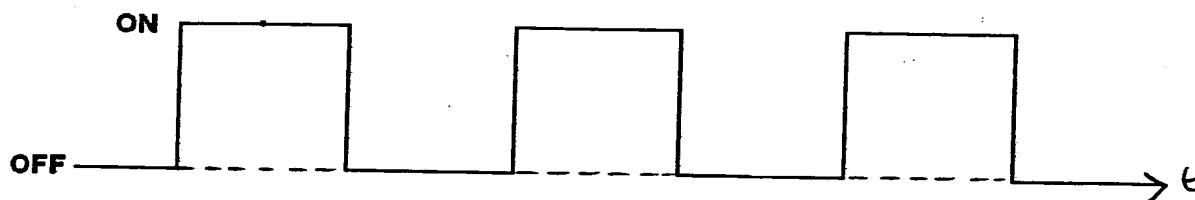


Fig 10

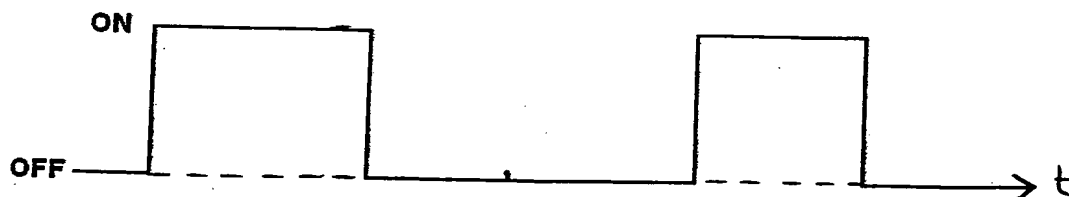


Fig 11

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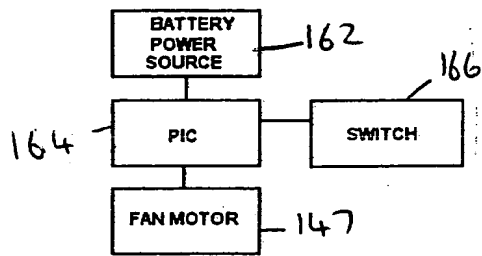


Fig 12

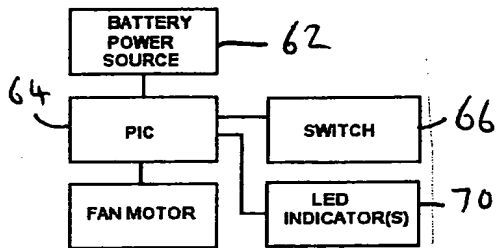


Fig 8

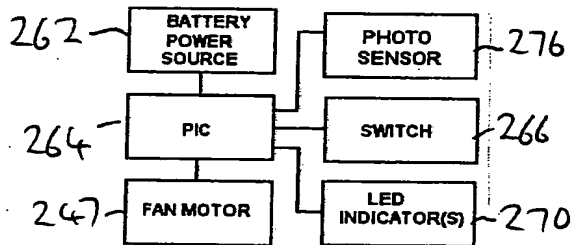


Fig 13

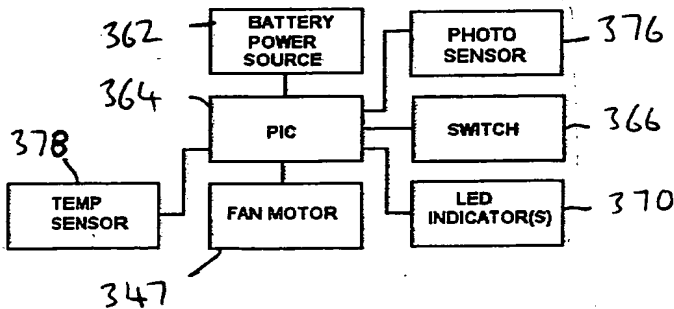


Fig 14

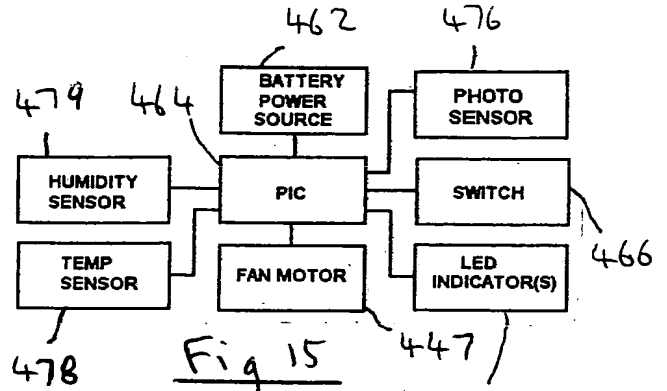


Fig 15

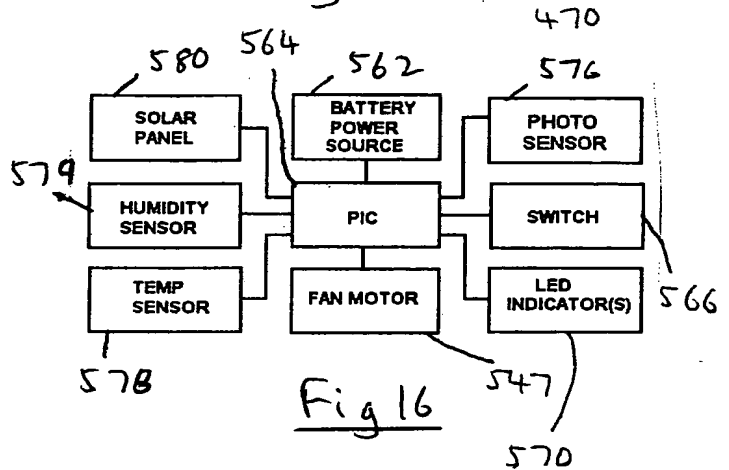


Fig 16

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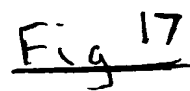


Fig 17

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